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ABSTRACT

Computer-aided drawing can bring new technology into the drafting classroom. One approach to computer-aided drafting (CAD) involves use of a personal computer and purchased software. Existing school computers could be shared to reduce costs. Following this narrative introduction, a suggested curriculum for the teaching of CAD is presented in outline form. It encompasses specific, prioritized elements that can be adjusted to fit into an existing program or used to teach a full CAD program. The outline is based on the DACUM (Developing a Curriculum) process. The format of the suggested course of study is as follows: the information on the left is a prioritized list of necessary task statements and corresponding duties to be used in the curriculum development process, while the information on the right represents the derived curriculum elements necessary for the actual instruction of a computer drawing technician. Eighteen topics are introduction, hardware system descriptions and operation, software, system operating modes, command entry methods, command processing, understanding design criteria, creation and manipulation of drawing data, text dimensioning, digitizing, three-dimensional database concepts, creating three-dimensional objects, cutting sections, organizing operational parameters, capabilities of entire system, identification and correction of system's problems, and professional development. (YLB)

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A SUGGESTED COMPUTER AIDED DRAFTING CURRICULUM

(Dacum Based)

Paper Presented at the
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A SUGGESTED COMPUTER AIDED DRAFTING CURRICULUM

(Dacum Based)

During the late 1970's and into the present decade we have witnessed many changes in the industrial workplace which affect what we teach in the industrial education curriculum. We can no longer continue teaching the traditional areas of industrial education without adjusting the curriculum to encompass new developments. It would be difficult to defend a program, for example, that didn't include electronic ignition operation in the automotive area, integrated circuit technology in electronics, numerical control and robotics in machine operation or computer aided drafting in a drafting program. In many cases adequate funds and equipment preclude dealing with these innovations in an in-depth manner. However, instructional units can be designed and integrated into existing curricula and use made of teaching aids, mock-ups, film media or field trips to local business and industry.

One of the study areas traditionally offered in industrial education is drafting or industrial drawing and design. Courses offered in a typical program often focus on either mechanical or architectural drafting and utilize the traditional drawing instruments of T-square, scales, lead holder, eraser, compass, divider and possibly a drafting machine. Even though these tools are still being used in industry and will be for some time, a new instrument, the computer, has been added and will eventually eliminate the need for many tools just mentioned.

The value of the computer in drafting is that it can perform

many operations very quickly and without the need of using a drawing medium such as paper, vellum or mylar until a final project is completed. The computer thus becomes an invaluable aid for the draftsman and while not eliminating the need for understanding and using basic drawing concepts, it does de-emphasize the use of traditional drafting instruments.

Integrating computer aided drafting into a drawing program is not an easy task. However, new technology must be brought into the classroom and what better way in drafting than the introduction of computers through computer aided drawing. One possible approach would be to use a personal computer with such brand names as IBM, Apple, Radio Shack, Atari and Hewlett-Packard. Applicable software such as MATCCAD, CADDRAW, CADDRAFT, VERSACAD, CADAPPLE, etc., can be purchased and utilized. To reduce costs it might be possible to introduce CAD without actually purchasing a computer. Components such as a tablet, joystick and appropriate software can be purchased separately and used with already existing school computers shared with math, science and computer programming departments.

A suggested curriculum for the teaching of CAD is presented below in outline format and encompasses specific, prioritized elements which can be used and adjusted to fit into an existing program or utilized to teach a full CAD program. It is suggested at this point that students be required to have some training in basic drafting before attempting to adjust to computer drawing.

The outline is based on the DACUM process and was developed in concert with an industrial-based advisory committee. This group reflected the specific needs of industry with respect to the training of a computer drafting technician as seen from the

perspective of a manager. DACUM operates on the following three premises: (1) expert workers are better able to describe/define their job than anyone else, (2) any job can be effectively and sufficiently described in terms of the tasks that successful workers in that occupation perform, and (3) all tasks have direct implications for the knowledge and attitudes that workers must have in order to perform the tasks correctly. A carefully chosen group of experts from industry were selected as the committee (See Appendix). Work was undertaken to develop task statements and duties needed by persons to be trained in CAD. From this effort a curriculum was design which reflects the current needs of industry.

The format of the suggested course of study is as follows: the information on the left is a prioritized list of necessary task statements and corresponding duties to be utilized in the curriculum development process as generated by the Dacum committee. The information on the right represents the derived curriculum elements necessary for the actual instruction of a computer drawing technician. Presentation techniques, resource materials, hardware and software are within the perview of those delivering actual instruction.

The course of study follows and if properly implemented should increase the appeal of a drafting program. It will also reflect the latest computer technology available to the draftsman.

COMPUTER AIDED DESIGN DRAFTING

-Course Outline-

Prioritized DACUM Chart

CATEGORY A

Task Statement:

UTILIZE THE COMPUTER

Duties:

1. Log On and Off the System
2. Select Appropriate Program(s)
3. Utilize Appropriate Input and Output Devices
4. Maintain Proper Environment
5. Operate Keyboard Proficiently

DACUM-based Course of Study

I. INTRODUCTION TO COMPUTER AIDED DRAFTING

A. Terminology and Definitions
B. CAD verses Conventional Drafting
C. Expected Growth & Employment Outlook
D. Effects of Computers on the Individual and Society
E. Industry Expectations of CAD Operators
F. Composition of a CAD System

II. HARDWARE SYSTEM DESCRIPTIONS & OPERATION

A. Work Station

1. Graphics Display - CRT
2. Tablet
3. Electronic Stylus - Pen
4. Alphanumeric Keyboard
5. Function Keyboard
6. Interfaces

B. Central Processing Unit (CPU)

1. Central Processor
2. Disk Drives
3. Magnetic Tapes

Prioritized DACUM Chart	DACUM-based Course of Study
CATEGORY A Continued	C. Peripheral Equipment 1. Plotter 2. Hardcopy Unit - Printers 3. Alphanumeric Terminals
	III. SOFTWARE A. Operational Software B. Applications Software C. User Software D. Protected and Unprotected Software
	IV. SYSTEM OPERATING MODES A. Control Mode B. Edit Mode
CATEGORY B	V. COMMAND ENTRY METHODS A. Uses of Input Devices 1. Tablet Operations 2. Electronic Pen 3. Function Keyboard 4. Menu 5. Alphanumeric Keyboard
	VI. COMMAND PROCESSING A. Syntax B. Command Execution C. Return Key D. End of Command

CATEGORY C

Task Statement:

INTERPRET DESIGN CRITERIA

Duties:

1. Establish Job and Task Scope
2. Interact with Design Team
3. Plan Approach
4. Establish Time Frame

CATEGORY D

Task Statement:

PREPARE PRELIMINARY DRAWINGS

Duties:

1. Identify Components
2. Create Data Base File
3. Set Screen/Drawing Parameters
4. Lay Out the Drawing
5. Utilize Symbols
6. Utilize Text
7. Select Key Dimensions
8. Produce Check Prints
9. Obtain Approvals

VII. UNDERSTANDING DESIGN CRITERIA

A. Discuss Project with Designers

1. Establish Scope of Drafting work

B. Establish Job Task Scope

1. Plan Work Approach
2. Establish Time Frame

VIII. CREATION AND MANIPULATION OF DRAWING DATA

A. Logging In (System Entry)

1. Security (Password)
2. Loading Drawing Files

B. Use of Operating Modes

1. Storing Drawing Data

C. Manipulating Geometry

1. Using the Grid System
2. Moving Geometry
3. Deleting Geometry
4. Changing Shape of Geometry
5. Rotating Geometry
6. Copying
7. Mirroring
8. Multiple Copies

CATEGORY D Continued

9. Adding Lines

    a. Horizontal
    b. Vertical
    c. Diagonal

10. Line Types

    a. Solid-Single Weight
    b. Solid-Multiple Weight
    c. Center Lines
    d. Hidden Lines
    e. Phantom Lines

11. Adding Arcs

    a. Interior and Exterior
    b. Full Circles

12. Adding Ellipses

IX. TEXT

A. Character Set
B. Display of Text
C. Text Selection
D. Adding Text

1. Text in Free Space
2. Inserting into a Text String
3. Text String Modifications
4. Upper and Lower Case Text
5. Fractions and Decimals

CATEGORY D Continued

CATEGORY E

Task Statement:

PREPARE FINISHED DRAWINGS

Duties:

1. Finalize Drawing Parameters
2. Modify Drawing to Conform to Standards
3. Select Final Dimensions
4. Incorporate Reference Data and Standard Notations
5. Select Output Parameters
6. Prepare Finish Check Prints
7. Produce Final Drawings

E. Editing of Text

1. Deleting from Text String
2. Inserting into a Text String
3. Text String Modifications

a. Changing Font
b. Changing Text Size
c. Changing Line Weight

F. Manipulating Text

1. Fitting Text to Available Space
2. Moving Text
3. Copying Text
4. Rotating Text

G. Alphanumeric Keyboard Characters

X. DIMENSIONING

A. Conventional Dimensioning

1. Selection Process
2. Linear Dimension Addition

a. Horizontal Dimensions
b. Vertical Dimensions
c. Angled Dimensions

3. Arcs
4. Circles
5. Leader Lines
6. Tolerances

a. Plus and Minus
b. High and Low Limits

Prioritized DACUM Chart

DACUM-based Course of Study

CATEGORY E Continued

7. Dual Dimensioning

B. Baseline Dimensioning
C. Modifying Dimensions
D. Geometric Tolerancing

1. Symbols

XI. DIGITIZING

A. Digitizing Devices

1. Small Tablet with Stylus
2. Large Tablet with Stylus
3. Tablet and Puck with Function Buttons

B. Digitizing Commands and Operation

1. Command Format and Interpretation
2. Aborting Commands

C. Setting Up for Digitizing

1. Dividing a Tablet Area

D. Adding Components

1. Lines
2. Arcs
3. Cells

E. Three-Dimensional Addition
F. Using Menus and Functions Buttons

6

Prioritized DACUM Chart

CATEGORY E Continued

DACUM-based Course of Study

XII. THREE-DIMENSIONAL DATA BASE CONCEPTS

A. Natural Units (inches-mm)

1. Setting Natural Units

B. The View Cube

1. Three-Dimensional Zooming
2. Defining the View Cube
3. Manipulating the Location and Size of the View Cube

a. Centering the View Cube
b. Moving the View Cube
c. Changing the Size of the View Cube
d. Viewing the Entire Drawing

C. Saving and Getting Views
D. Controlling the Number and Types of Views

1. Orthographic Principal Views
2. Isometric Views
3. Dimetric Views
4. Trimetric Views
5. Single Auxiliary Views
6. Multiple Auxiliary Views
7. Rotating the View Cube
8. Perspective Views

E. Grids

1. Working Grid
2. Secondary Grid

CATEGORY E Continued

CATEGORY F

Task Statement:

MAINTAIN SUPPORT FILES

Duties:

1. Create and Maintain Drawing Index
2. Create and Maintain Drawing Files
3. Implement Security Procedures for Protection of File Media
4. Implement Appropriate Back-up Procedure

F. Drawing Levels

1. Setting Level Status

a. Edit
B. Reference

XIII. CREATING THREE-DIMENSIONAL OBJECTS

A. Setting the Planes
B. Outlining of Selected Shapes
C. Creating Edges Between Faces
D. Surfaces of Revolution

XIV. CUTTING SECTIONS

A. Through Plane Faced Objects
B. Through Surfaces of Revolution
C. Cross Hatching

XV. ORGANIZING OPERATIONAL PARAMETERS

A. Develop, Catalog and Utilize Operational Index System
B. Develop, Catalog and Utilize Drawing File System
C. Identify and Use Appropriate Security Measures for File System
D. Design and Maintain Adequate Back-up Protection Procedure

Prioritized DACUM Chart

CATEGORY G

Task Statement:

EXPLOIT SYSTEM"S MAXIMUM CAPABILITIES

Duties:

1. Learn System Capabilities
2. Communicate System Capabilities
3. Apply Knowledge to Achieve Maximum Proficiency

CATEGORY H

Task Statement:

TROUBLESHOOT SYSTEM PROBLEMS

Duties:

1. Identify Problem
2. Document Problem
3. Resolve Minor Problems
4. Refer to Appropriate Help Sources

DACUM-based Course of Study

XVI. CAPABILITIES OF ENTIRE SYSTEM

A. System's Potential Strengths
B. System's Weakness
C. System's Maximum Capabilities

XVII. IDENTIFICATION AND CORRECTION OF SYSTEM"S PROBLEMS

A. Identify and Analyze Problem
B. Generate Potential Solutions
C. Correct Minor Problems
D. Refer Major Problems

Prioritized DACUM Chart

CATEGORY I

Task Statement:

REMAIN CURRENT IN FIELD

Duties:

1. Participate in User Groups
2. Access Vendor Updates
3. Participate in Professional Associations
4. Continue Education
5. Use Current Publications

DACUM-based Course of Study

XVIII. PROFESSIONAL DEVELOPMENT

A. Current Literature and Updates
B. Professional and Technical Associations
    1. Active Participation
C. Identifying and Using Reference Materials
D. Technical Conference Participation
E. Advanced Education Training
    1. Workshops
    2. Community College and Technical Institute Classes
    3. College and University Professional Study

APPENDIX

DACUM INFORMATION SHEET

What is DACUM (Developing A CurriculuM)?

DACUM is a relatively new and innovative approach to occupational analysis. It has proven to be a very effective method of quickly determining, at relatively low cost, the competencies or tasks that must be performed by persons employed in a given job or occupational area.

The profile chart that results from the DACUM analysis is a detailed and graphic portrayal of the skills or competencies involved in the occupation being studied. The DACUM analysis can be used as a basis for (1) curriculum development, (2) student learning, (3) training needs assessments, (4) worker performance evaluations, and (5) competency test development.

DACUM has been successfully used to analyze occupations at the professional, technical, skilled, and semiskilled levels. DACUM operates on the following three premises: (1) expert workers are better able to describe/define their job than anyone else, (2) any job can be effectively and sufficiently described in terms of the tasks that successful workers in the occupation perform, and (3) all tasks have direct implications for the knowledge and attitudes that workers must have in order to perform the tasks correctly.

A carefully chosen group of about 10-12 experts from the occupational area form the DACUM committee. Committee members are recruited directly from business, industry, or the professions. The committee works under the guidance of a facilitator for two days to develop the DACUM chart. Modified small-group brainstorming techniques are used to obtain the collective expertise and consensus

of the committee.

The DACUM committee is carefully guided through each of the following steps by the coordinator:

1. Orientation
2. Review of job or occupational area description
3. Identification of general areas of job responsibility
4. Identification of specific tasks performed in each of the general areas of responsibility
5. Review and refinement of task statements
6. Sequencing of task statements
7. Identification of entry-level tasks
8. Other options, as desired

Because of their current occupational expertise, committee participants do not need to make any advance preparations. Participants on past DACUM committees have, without exception, found the activity to be a professionally stimulating and rewarding experience.

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